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Revision 0

Interim Status Groundwater Monitoring Plan for the 216-B-63 Trench

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
Richland, Washington 99352

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Executive Summary

This document presents a revision to the 2002 groundwater monitoring plan for the 216-B-63 Trench.[1] This revised monitoring plan is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA)[2] and the *Revised Code of Washington* (RCW) 70.105.[3]

The B-63 Trench is an non-operating treatment, storage, and disposal (TSD) unit in the 200-CS-1 Chemical Sewer Operable Unit. The B-63 Trench is regulated as a surface impoundment and has been designated as a TSD unit because it received nonradioactive dangerous waste regulated by 40 *Code of Federal Regulations* (CFR) 261[4] after November 19, 1980.

This RCRA groundwater monitoring plan presents a revised groundwater contamination indicator evaluation monitoring program that will detect any adverse impact from past operations of the B-63 Trench on groundwater quality in the uppermost aquifer beneath the TSD unit. This document addresses the operational history, current hydrogeology, and groundwater monitoring results for the site and incorporates the sum of knowledge about the potential for contamination originating from the B-63 Trench. A conceptual model is developed based on these attributes of the B-63 Trench and the data quality objectives process.

The B-63 Trench is located at the southwestern perimeter of the 218-E-12B Burial Ground (Low-Level Waste Management Area 2) in the 200 East Area. The B-63 Trench was an open, unlined ditch, approximately 427 m (1,400 ft) long, excavated as a percolation trench to receive radioactively contaminated cooling water from B Plant. In May 1970, the piping to the B-63 Trench was modified to receive chemical sewer wastes from B Plant. Operating records indicate that the B-63 Trench began receiving regular discharges of nonregulated cooling water from both B Plant and in-tank solidification unit 2 on March 22, 1970. Between May 1970 and February 1992, the B-63 Trench also received B Plant chemical sewer effluent containing corrosive wastes

1 PNNL-14112, 2002, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

2 *Resource Conservation and Recovery Act of 1976*, 42 U.S.C. 6901, et seq.

3 RCW 70.105, "Public Health and Safety," "Hazardous Waste Management," *Revised Code of Washington*.

4 40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*.

from backwashing for the regeneration of demineralizer columns. All discharges ended in 1992, and the ditch underwent interim stabilization measures in 1994.

Because the B-63 Trench received wastewater contaminated with dangerous waste/dangerous waste constituents, a contamination indicator groundwater monitoring program was implemented in 1988. To date, statistical analyses of the RCRA interim status indicator parameters (pH, specific conductance, total organic carbon, and total organic halides) have not shown exceedances. No dangerous waste subject to *Washington Administrative Code* (WAC) 173-303[5] has contaminated the groundwater beneath the B-63 Trench. Therefore, the site remains under detection monitoring for indicator parameters.

Data from the 12 groundwater monitoring wells that currently comprise the B-63 Trench monitoring network were re-evaluated to determine if redundant wells could be dropped. Based on this re-evaluation, the former network of 12 wells is being reduced to 7 wells (Figure ES-1). The revised network is made up of two upgradient wells and five downgradient wells.

The groundwater in the B-63 Trench monitoring wells will be sampled and analyzed semiannually for the indicator parameters of total organic carbon, total organic halides, pH, and specific conductance. Additional parameters (i.e., alkalinity, dissolved oxygen, temperature, and turbidity) will be measured as indicators of groundwater quality and general aquifer/well environmental conditions. All wells will be sampled annually for selected metals, anions, and phenols. Water-level measurements will be taken semiannually.

5 WAC 173-303-040, "Dangerous Waste Regulations," "Definitions," *Washington Administrative Code*.

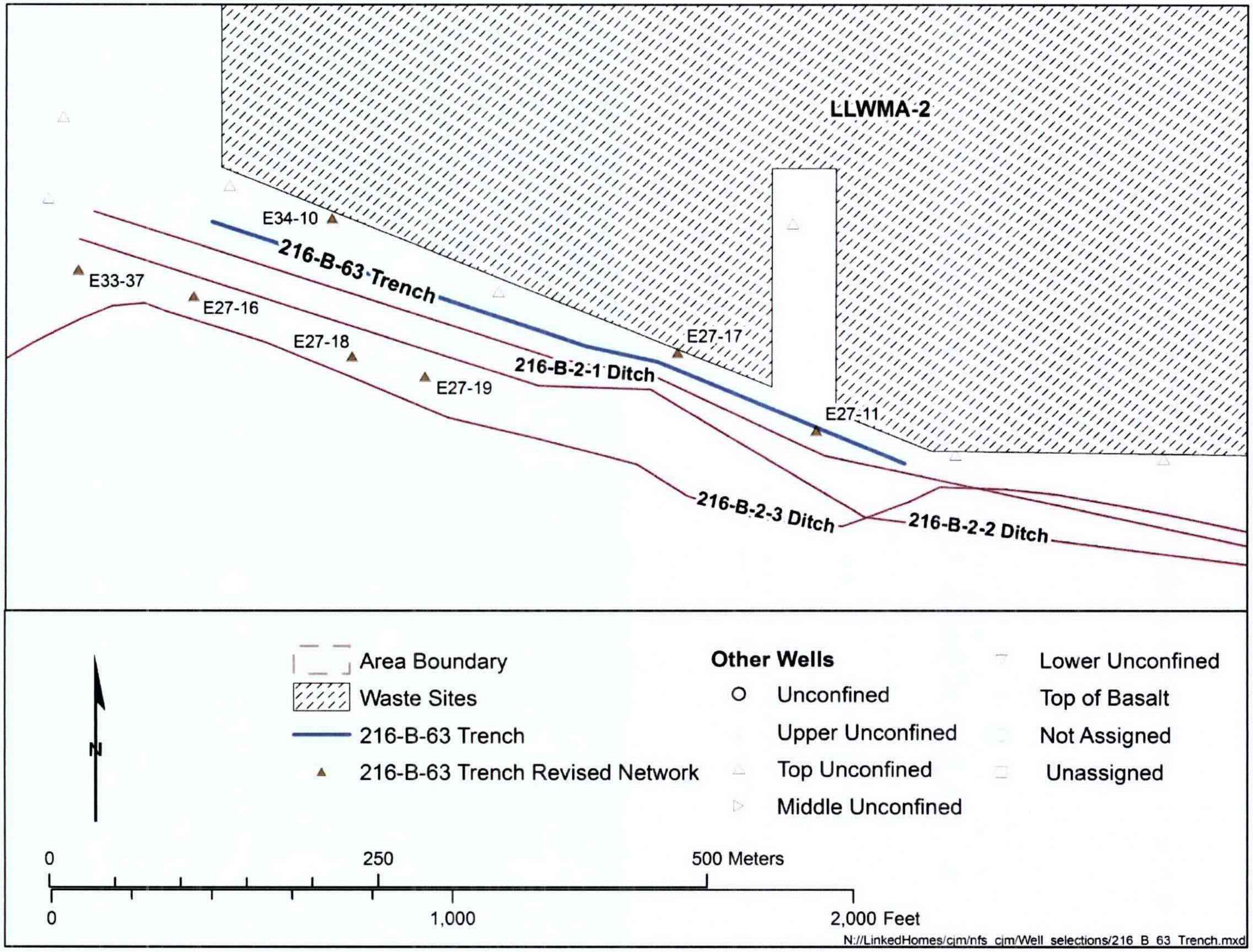

Figure ES-1. Revised 216-B-63 Trench Monitoring Network Wells

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Terms

bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
DQO	data quality objective
Ecology	Washington State Department of Ecology
LLWMA	low-level waste management area
OU	operable unit
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
TOC	total organic carbon
TOX	total organic halides
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

1 Introduction

This document presents and supersedes the 2002 groundwater monitoring plan for the 216-B-63 Trench (hereafter referred to as the B-63 Trench) (PNNL-14112, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site*). This groundwater monitoring plan is based on requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA) and *Revised Code of Washington* (RCW) 70.105, "Public Health and Safety," "Hazardous Waste Management." Regulations are promulgated by the Washington State Department of Ecology (Ecology) in *Washington Administrative Code* (WAC) 173-303-400 ("Dangerous Waste Regulations," "Interim Status Facility Standards"), and by reference 40 *Code of Federal Regulations* (CFR) 265, Subpart F ("Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring").

The B-63 Trench is one of three non-operating treatment, storage, and disposal (TSD) units in the 200-CS-1 Chemical Sewer Operable Unit (OU). The B-63 Trench is regulated as a surface impoundment, as defined in WAC 173-303-040, "Definitions." The B-63 Trench has been designated as a TSD unit because it received nonradioactive dangerous waste regulated by 40 CFR 261 ("Identification and Listing of Hazardous Waste") after November 19, 1980. For regulatory purposes, the TSD unit boundary of the B-63 Trench is identified on the current Dangerous Waste Permit Application Part A Form (WA7890008967, *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*).

Closure of the B-63 Trench will be coordinated with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), as part of the 200-CS-1 OU (vadose zone). Associated groundwater concerns will be addressed under the 200-BP-5 Groundwater OU.

The B-63 Trench is located at the southwest perimeter of the 218-E-12B Burial Ground (Low-Level Waste Management Area 2 [LLWMA-2]) in the 200 East Area (Figure 1-1). The B-63 Trench was excavated as a percolation trench to receive radioactively contaminated cooling water from B Plant. In March 1970, the piping to the B-63 Trench was modified to receive chemical sewer wastes from B Plant. Figure 1-2 is an aerial photograph from 1971 showing the B-63 Trench in relation to the then-operational 216-B-2-3 Ditch leading to the 216-B-3 Pond. Operating records indicate that the B-63 Trench began receiving effluent on March 22, 1970. All discharges ended in 1992, and the ditch underwent interim stabilization measures in 1994.

This groundwater monitoring plan presents a revised groundwater contamination indicator evaluation monitoring program for the B-63 Trench that will detect any adverse impacts from past operations on the quality of the groundwater in the uppermost aquifer beneath the TSD unit (40 CFR 265.93[d], "Preparation, Evaluation, and Response"). This document addresses the operational history, current hydrogeology, and groundwater monitoring results for the site and incorporates the sum of knowledge about the potential for contamination originating from the B-63 Trench. A conceptual model is developed based on these attributes of the B-63 Trench and the data quality objectives (DQO) process. The groundwater monitoring program presented in this plan is intended specifically to satisfy monitoring requirements for TSD units, as required by WAC 173-303-400(3).

The groundwater contamination indicator evaluation monitoring program detailed in this monitoring plan proposes continued semiannual sampling for indicator parameters and annual sampling of groundwater quality parameters at two upgradient and five downgradient wells.

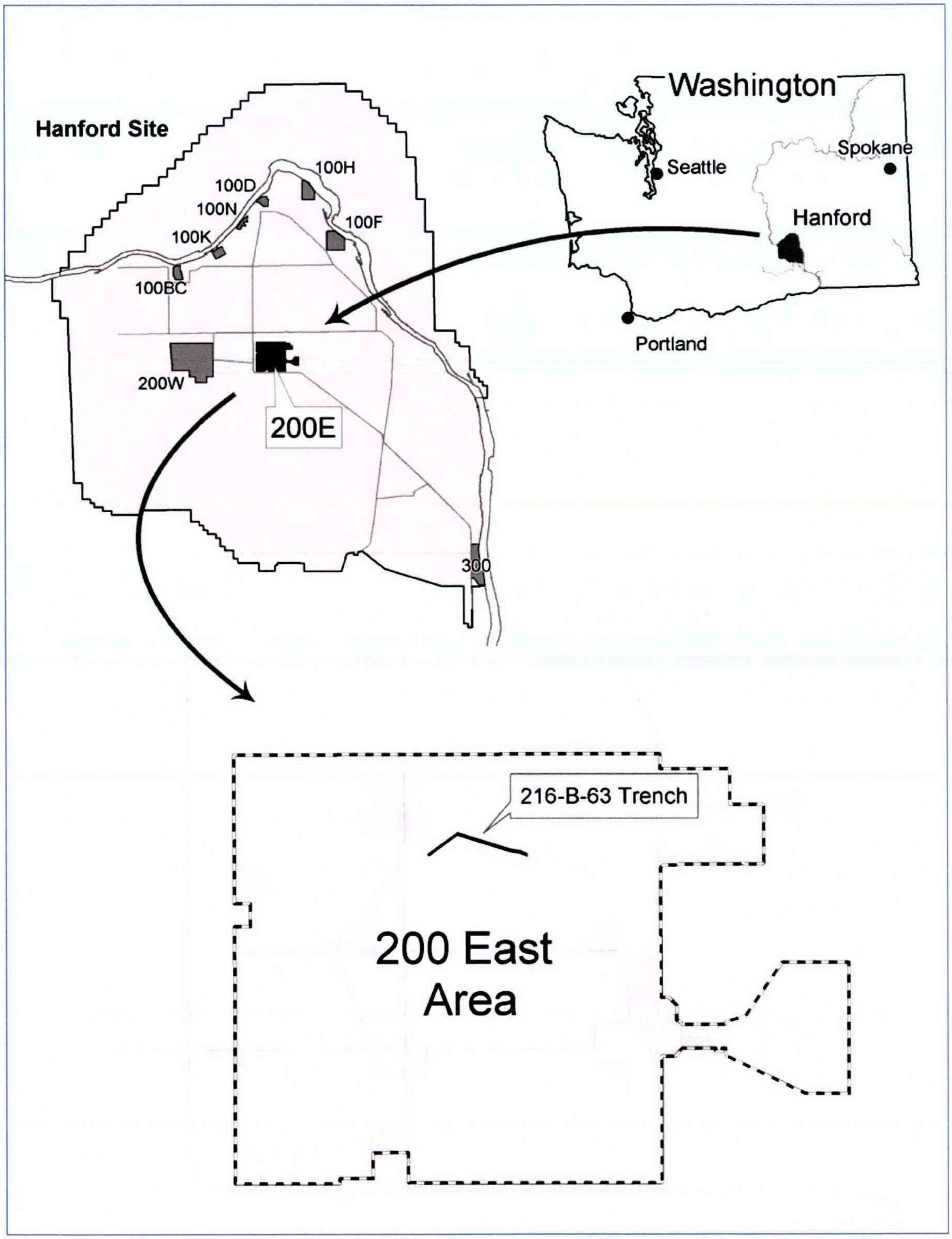

Figure 1-1. Location of the 216-B-63 Trench

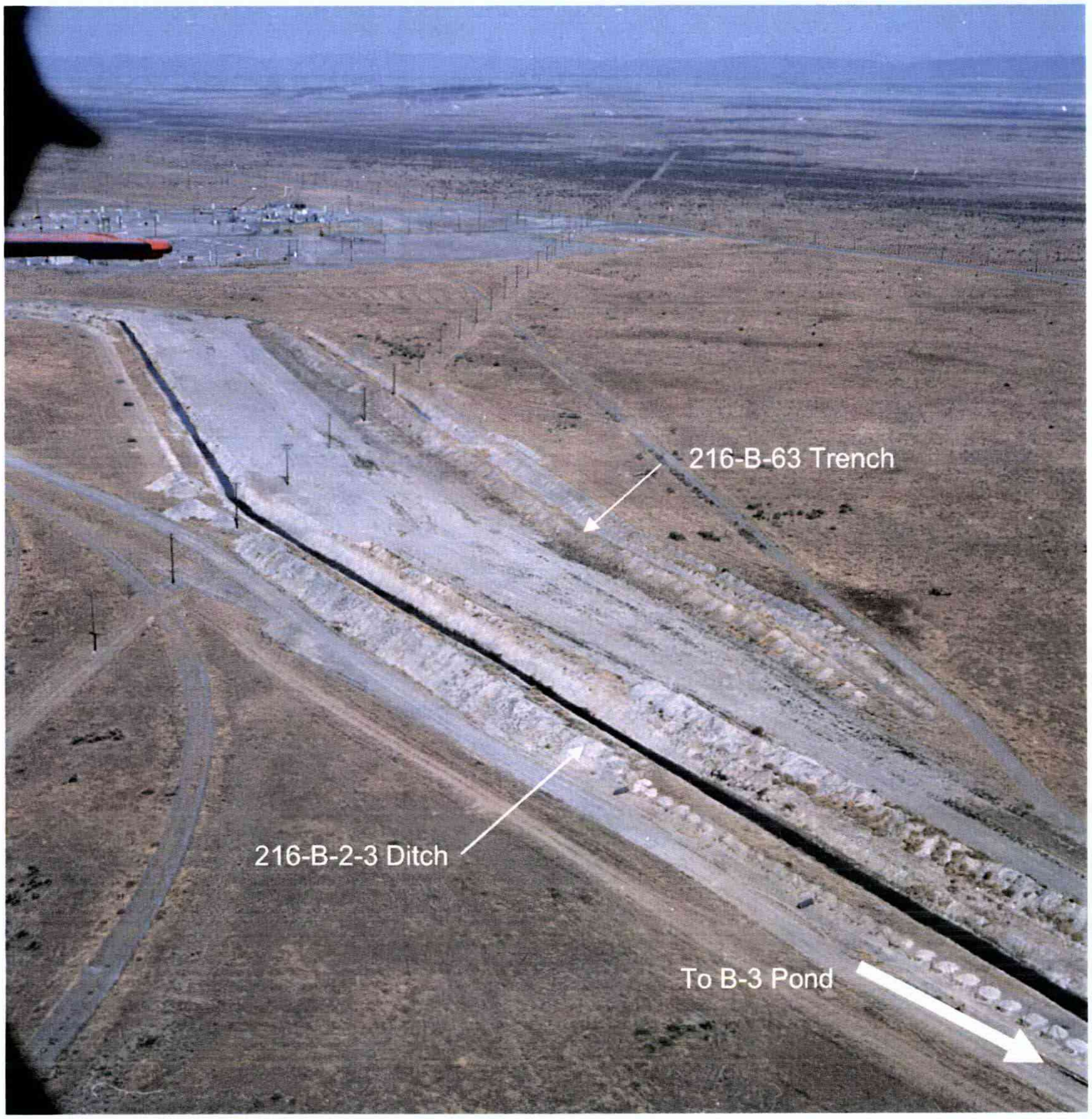

Figure 1-2. Photo Looking Toward the Northwest Showing the 216-B-2-3 Ditch and 216-B-63 Trench

Chapter 1 provides a general introduction to the monitored waste site, including objectives of the current monitoring program. Chapter 2 presents background information related to the successful implementation of the groundwater monitoring plan, which includes information on historical and present operations, waste characteristics, geology, hydrology, previous monitoring results, and a site conceptual model. Chapter 3 presents details of the monitoring program, while data evaluation and reporting are discussed in Chapter 4. Chapter 5 includes the references that are cited. Detailed procedures covering sample collection, preservation, shipment, analytical procedures, and documentation (e.g., chain-of-custody) are provided in the quality assurance project plan (QAPjP) in Appendix A.

2 Background

This chapter presents background information related to the successful implementation of the groundwater monitoring plan, which includes information on historical and present facility operations, waste characteristics, geology, hydrology, previous monitoring results, and a site conceptual model. The information in this section was adapted from *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan* (DOE/RL-99-44).

2.1 Facility Description and Operational History

The trench boundary is located at the southwest perimeter of the 218-E-12B Burial Ground (LLWMA-2) in the 200 East Area (Figure 2-1). The B-63 Trench was an open, unlined, manmade excavation that was approximately 427 m (1,400 ft) in length. During operational use, the trench was approximately 1.2 m (4 ft) wide with an average depth of 3 m (10 ft). The discharge to the trench was at the west end through a 40.6 cm (16-in.) inlet pipe buried approximately 1 m (3 ft) below grade. A bed of 5.1 cm (2-in.) rip-rap rock for splash control extended approximately 3.1 m (10 ft) down the trench from the discharge pipe.

The B-63 Trench was constructed prior to 1970 (possibly as early as 1963) as an emergency percolation trench to receive radioactively contaminated cooling water from B Plant (RHO-CD-673, *200 Areas Waste Sites*). According to the Waste Information Data System database, the B-63 Trench received effluent from 221-B (B Plant), 225-B (Waste Encapsulation and Storage Facility), and 271-B (B Plant office and service building). Unlike the other B-series trenches, the B-63 Trench was not connected to the B Pond system. This was an intentional design, as the B-63 Trench was to receive diverted radioactively contaminated cooling water and prevent it from reaching the B Pond.

Operations at the B-63 Trench began on March 22, 1970, after an unplanned release of radioactively contaminated wastewater to the 216-B-2-2 Ditch (UPR-200-E-138). The B-63 Trench received cooling water from both B Plant and in-tank solidification unit number 2 from March 1970 to May 1970 (ARH-2015, *Radioactive Liquid Wastes Discharged to the Ground in the 200 Areas During 01/01/1970 Thru 2/31/1970*). From May 1970 until February 1992, the trench also began receiving B Plant chemical sewer effluent. Source contributors to the B Plant chemical sewer included floor, funnel, and sink drains; steam condensate and/or cooling water; tank overflow and drain effluent; swamp cooler effluent; and rainwater. The trench was removed from service in 1992, when the B Plant chemical sewer effluent was combined with the B Plant cooling water effluent and discharged directly to the B-3 Pond. Figure 2-2 shows the annual and cumulative discharges to the B-63 Trench.

Interim stabilization measures were completed at the B-63 Trench in November 1994. Indications from test pits excavated across the B-63 Trench in late 2002 and early 2003 are that the site was backfilled by pushing the soil piles from the original trench excavation, which had been staged along the length of the trench, back into the open ditch. This is supported by the finding of oxidized soils and vegetation between 1.5 and 2.3 m (5 and 7.5 ft) below ground surface (bgs) (WMP-17755, *200-CS-1 Operable Unit Field Summary Report for Fiscal Year 2003*). The site was then revegetated and radiologically down-posted in status from a surface contamination area to an underground radioactive material area. The site was permanently isolated by filling the weir box at the head end of the ditch with concrete on December 12, 1994. Prior to stabilization, the ditch had an earthen shielding berm and a side slope of approximately 10:6.

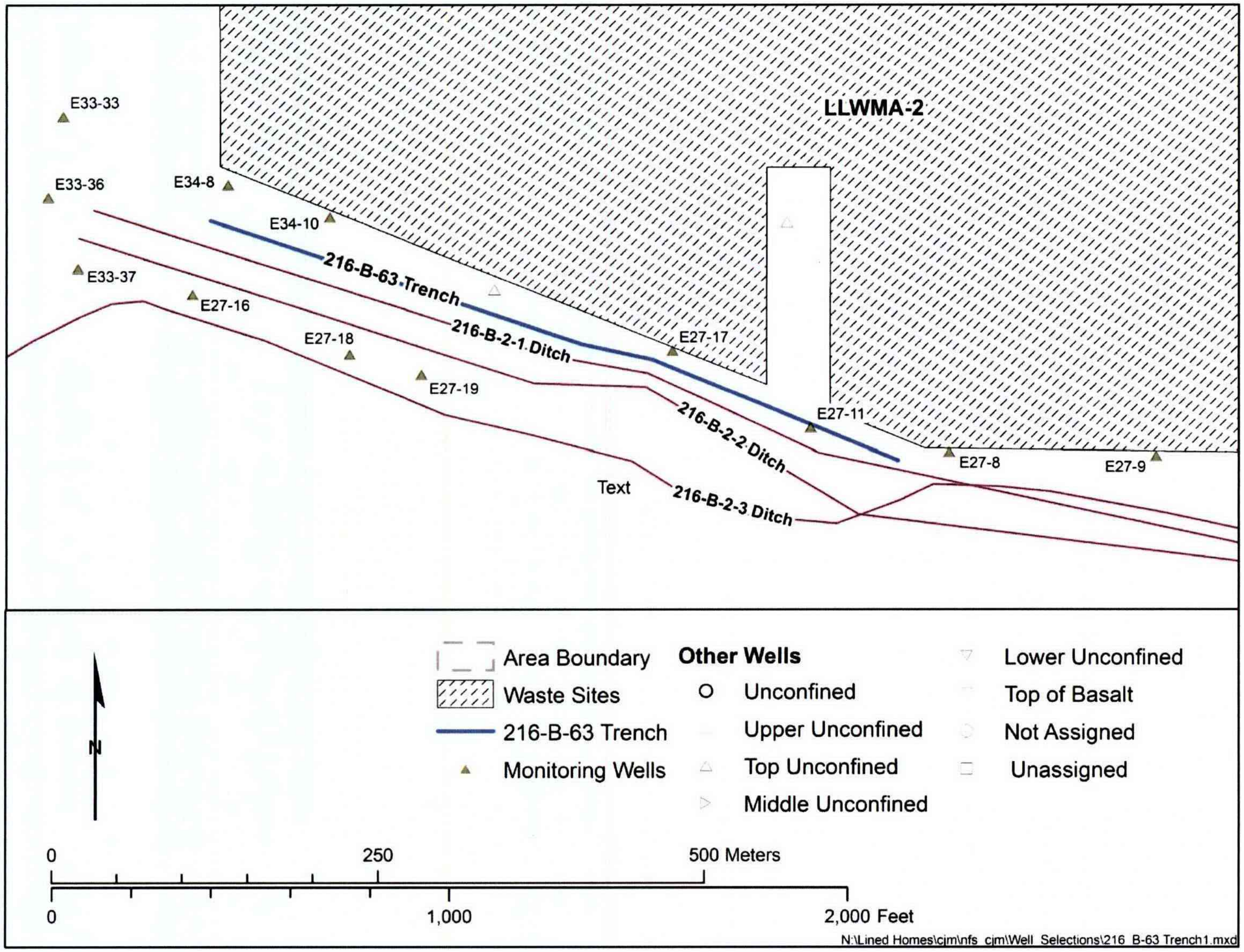

Figure 2-1. Site Map for the 216-B-63 Trench Showing Current Well Network

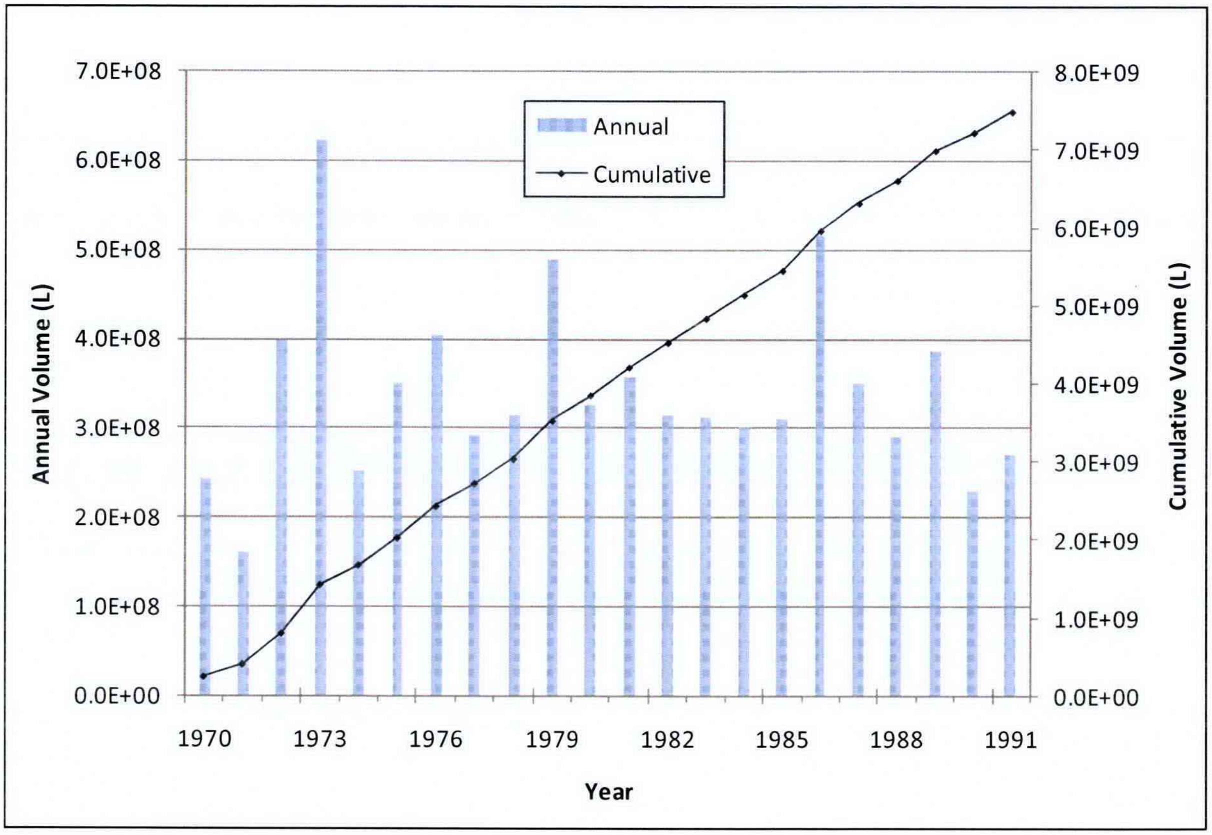

Figure 2-2. Effluent Volume Discharged to the 216-B-63 Trench

2.2 Regulatory Basis

The B-63 Trench is classified as a TSD unit because it received dangerous waste after one of two effective dates. The effective dates for nonradioactive dangerous waste discharges are November 19, 1980, for dangerous waste regulated by 40 CFR 261; or March 10, 1982, for dangerous waste regulated by WAC 173-303 only (e.g., state-only dangerous waste). Since the corrosive waste (D002) discharged to the B-63 Trench is regulated under 40 CFR 261, the effective date of regulation for this unit is November 19, 1980 (see definition of "active portion" in WAC 173-303-040).

The B-63 Trench is currently subject to the regulations of WAC 173-303-400 and those portions of 40 CFR 265, Subpart F, as incorporated by reference in WAC 173-303-400.

To date, no dangerous waste subject to WAC 173-303 has contaminated groundwater from the B-63 Trench. Therefore, the site remains under indicator evaluation monitoring for indicator parameters as specified in 40 CFR 265.92(b), "Sampling and Analysis."

The B-63 Trench received regular discharges of corrosive waste (D002) from the B Plant demineralizers from 1970 through 1985. After September 1985, demineralizer regeneration wastewater was neutralized before discharge to the B-63 Trench. Between May 1970 and February 1992, the B-63 Trench also received B Plant chemical sewer effluent.

Groundwater monitoring began at the B-63 Trench in 1988. Under RCRA interim status requirements, the B-63 Trench is required to implement a contamination indicator groundwater monitoring program because it received dangerous waste discharged into the wastewater from B Plant. Discharges to the B-63 Trench were discontinued in 1992.

2.3 Waste Characteristics

The B-63 Trench received corrosive dangerous waste (aqueous sodium hydroxide and sulfuric acid) from the regeneration of demineralizer columns in B Plant. Through 1985, treatment occurred by the successive addition of acidic and caustic waste to the trench, which served to neutralize the waste in the trench. The daily average flow rate to the B-63 Trench varied between 378,000 and 1,408,000 L/day (100,000 and 600,000 gal/day). The designated corrosive waste discharges averaged (473,000 L/day (125,000 gal/day) from 1970 to 1992 (DOE/RL-2005-63, *Feasibility Study for the 200-CS-1 Chemical Sewer Group Operable Unit*). The actual corrosive portion from the demineralizers was less than 1,890 L/day (500 gal/day), while the remainder was once through cooling water.

Along with the regeneration waste, the B-63 Trench also received waste liquids from floor, funnel, and sink drains; steam condensate and/or cooling water; tank overflow and drain effluent; swamp cooler effluent; and rainwater from B Plant (221-B), Waste Encapsulation and Storage Facility (225-B), and B Plant office and service building (271-B).

The results of B Plant effluent analyses are provided in *B Plant Source Aggregate Area Management Study Report* (DOE/RL-92-05). Additional analysis data are provided in *Waste Stream Characterization Report* (WHC-EP-0287) and *Liquid Effluent Study Final Project Report* (WHC-EP-037). The identity and quantity of dangerous waste disposed in the B-63 Trench are listed in the RCRA Part A Form. The only dangerous waste disposed was corrosive waste.

2.4 Geology and Hydrology

The geology and hydrology of the B-63 Trench are described in detail in *Interim-Status Groundwater Monitoring Plan for the 216-B-63 Trench* (WHC-SD-EN-AP-165) and in compilation reports on the 200 East Area (e.g., WHC-SD-EN-TI-012, *Geologic Setting of the 200 East Area: An Update*; PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, the Hanford Site, Washington*). The following summary is taken from these documents.

2.4.1 Stratigraphy

The principal geologic units beneath the 200 East Area include, from oldest to youngest, the Elephant Mountain Member of the Saddle Mountains Basalt, the Miocene/Pliocene Ringold Formation, and the Pleistocene Hanford formation. PNNL-12261, upon which much of this section is based, uses the nomenclature first described in *Three-Dimensional Conceptual Model for the Hanford Site Unconfined Aquifer System: FY 1994 Status Report* (PNL-10195) in the vicinity of the 200 East Area. The nomenclature in PNNL-12261 is also referenced to the more recent descriptions provided in *Miocene- to Pliocene-Aged Suprabasalt Sediments of the Hanford Site, South-Central Washington* (BHI-00184).

Beneath the B-63 Trench, the Ringold Formation has been removed through erosion/flood activity, which leaves the Hanford formation in contact with the basalt bedrock. The Hanford formation averages approximately 75 m (246 ft) in thickness beneath the B-63 Trench. The Hanford formation is represented by three facies, in descending stratigraphic order: (1) an upper gravel sequence (H1), (2) a sandy sequence (H2), and (3) a lower gravel sequence (H3) (WHC-SD-EN-TI-012). The H1 and H3 gravel sequences are not differentiated in those areas where the intervening sandy H2 sequence is absent. Units H1 and H3 consist of coarse-grained, basalt-rich, sandy gravels with varying amounts of silt/clay. These units may also contain interbedded sand and or silt/clay lenses. The sandy H2 sequence is dominated by sand to gravelly sand, with minor sandy gravel or silt/clay interbeds. The sandy H2 sequence has a significant silt/clay component beneath most of the B-63 Trench. Only the wells around the inlet end of the trench show little silt content.

2.4.2 Physical Hydrogeology

The uppermost aquifer beneath the B-63 Trench is unconfined and occurs within the H2 and H3 facies of the Hanford formation. According to geologic records and as-built diagrams, existing shallow wells in the B-63 Trench monitoring network are completed within a sandy to gravelly sand unit. The water table elevation near and beneath the B-63 Trench is approximately 122 m (400 ft) above mean sea level (approximately 75 m [246 ft] bgs). The base of the unconfined aquifer is defined as the top of the Elephant Mountain Member of the Saddle Mountains Basalt and is approximately 118 m (387 ft) above mean sea level (approximately 80 m [262 ft] bgs).

From 1945 to 1995, groundwater flow direction and hydraulic gradients in most of the 200 East Area were highly influenced by the hydraulic mounding associated with discharges to the 216-B-3 Ponds, which lie to the east-southeast of the B-63 Trench. This groundwater mound is evident on water table maps through the 1990s. Groundwater flow during this period was generally to the west-northwest across the area. The termination of discharges to these ponds resulted in the groundwater mound dissipating, leading to a decline in groundwater elevations throughout the 200 East Area. This decline has produced a region of essentially flat groundwater gradients across the 200 East Area. This lack of appreciable gradient results in high uncertainty in the groundwater flow rate and direction. The saturated thickness of the unconfined aquifer beneath the B-63 Trench has declined from approximately 7 m (23 ft) in 2005 to 3.4 m (11 ft) by late 2009.

As noted above, the gradient beneath the B-63 Trench is extremely flat, making it difficult to define a dominant flow direction or rate with a large degree of confidence. As such, the designation of upgradient and downgradient wells is problematic. The pattern of increase and decline of anions (e.g., sulfate) in some wells suggest groundwater movement from the northwest to southeast at the western end of the TSD unit. During fiscal year 2008, flow direction was estimated as southeast, at a velocity of 0.87 m/day (2.85 ft/day), based on a gradient of 0.00096 m/m, a hydraulic conductivity of 182 m/day (597 ft/day), and an effective porosity of 20 percent.

2.5 Summary of Previous Groundwater Monitoring

Groundwater beneath the B-63 Trench has been monitored by a RCRA-compliant monitoring network since 1988. An aggressive schedule for installing wells specifically designed to meet RCRA guidance between 1987 and 1992 resulted in the installation of 12 monitoring wells that constitute the present B-63 Trench network. A total of five upgradient and seven downgradient wells surround the entire length of the trench. Many of these wells also serve the monitoring networks for LLWMA-2 and the single-shell tank farm Waste Management Area B-BX-BY. Groundwater monitoring results to date have not shown increases in regulated dangerous waste constituents attributable to discharges to the B-63 Trench.

2.5.1 Groundwater Contamination

Groundwater monitoring indicates that dangerous wastes/dangerous waste constituents from the B-63 Trench have not entered groundwater. Statistical analyses of the RCRA interim status indicator parameters (pH, specific conductance, total organic carbon [TOC], and total organic halides [TOX]), as specified in 40 CFR 265.92(b)(3), have shown no exceedances during the period of monitoring. Revised comparison values of these analyses, as well as discussion on regional contaminant plumes, are published annually in the Hanford Site annual groundwater report (e.g., DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*).

2.5.2 Vadose Zone Contamination

In 2002, a remedial investigation/feasibility study was completed for the 200-CS-1 Chemical Sewer Group OU, which included the B-63 Trench. Two boreholes and two test pits were excavated for this investigation, and no contaminants were found to be risk drivers at the site. Cadmium, nitrate, Aroclor-1260 (a polychlorinated biphenyl), benzene, and methylene chloride were found to have maximum concentrations above the State of Washington *Model Toxics Control Act* (WAC 173-340, "Model Toxics Control Act – Cleanup") groundwater protection cleanup levels in soil samples collected during characterization of the site; however, none of these constituents were predicted to reach the groundwater in concentrations exceeding groundwater quality levels (DOE/RL-2007-02, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units: Volume I: Work Plan and Appendices*, and *Volume II: Site-Specific Field-Sampling Plan Addenda*).

2.6 Conceptual Model

A conceptual model of contaminant transport through the vadose zone to groundwater beneath the B-63 Trench is used to develop an appropriate and cost-effective monitoring plan. The conceptualization begins with a summary of the physical and chemical conditions at the disposal site and related assumptions.

The B-63 Trench was one of several wastewater conveyances that discharged wastewater to the ground surface. The open and unlined nature of the B-63 Trench allowed the discharged liquid effluents to evaporate and percolate into the subsurface along the entire length of the trench. Should contamination be detected, it would most likely be found at the head end (west end) of the trench where constant head would have been maintained. Direct evidence for this type of non-uniform breakthrough to groundwater from a line source has been observed at the 216-A-29 Ditch, in which elevated sulfate concentrations were first observed in monitoring wells at the head end of the ditch.

The potential for migration of residual contamination from the vadose zone to groundwater has been greatly diminished since liquid effluent discharges to the B-63 Trench were terminated and there are no water lines or other direct sources of recharge. In addition to the lack of current driving force, the last recorded discharge was more than 20 years ago. The practice of releasing alternating low and high pH wastewater would also have served to neutralize the solutions within the trench. Any acidic wastewater that may have infiltrated before neutralization occurred would have been quickly neutralized within the vadose zone because of the high buffering capacity of the soil. Likewise, basic solutions would have little effect on soil chemistry.

Infiltration of precipitation is the only force capable of moving any of the remaining contaminants to groundwater. The current mean annual precipitation is 17.2 cm (6.8 in.), with most of the annual accumulation occurring between November and February (PNNL-18807, *Soil Water Balance and Recharge Monitoring at the Hanford Site – FY 09 Status Report*). Recharge in the B-63 Trench area is estimated at between 8.5 and 17 mm annually, based on values from *Vadose Zone Hydrogeology Data Package for Hanford Assessments* (PNNL-14702, Rev. 1). The range of recharge rates depends on a variety of factors, including soil type and vegetation cover. Because the B-63 Trench has been backfilled and is now covered with grasses, infiltration would likely be near the lower end of the range. No recent infiltration abatement measures (e.g., placement of an impermeable cap) have been implemented at the B-63 Trench.

Groundwater beneath the B-63 Trench resides in an unconfined system within the lower Hanford formation. The site-specific hydraulic conductivity reported in WHC-SD-EN-AP-165 ranges from 51.9 to 198.3 m/day (170.3 to 650.6 ft/day). Hydraulic conductivity is also assumed to be high regionally due to the lack of appreciable gradient across large portions of the 200 East Area. This low-gradient field leads to low flow velocities (generally on the order of centimeters per day) and difficulty in determining flow direction (DOE/RL-2008-66).

2.7 Data Quality Objectives

The DQO process is performed to ensure that data gathered during an investigation are of the appropriate quantity and quality to meet specific objectives. The DQOs for the groundwater indicator monitoring were presented in *200-CS-1 Chemical Sewer Operable Unit DQO Process Summary Report* (BHI-01276) and were revised in *Data Quality Objective Summary Report in Support of the 200-BP-5 Groundwater Operable Unit Remedial Investigation/Feasibility Study Process* (WMP-28945).

The current groundwater monitoring network for the B-63 Trench is a result of previous investigations and DQOs. Contamination indicator evaluation monitoring is ongoing at this site in accordance with interim status regulations. Table 2-1 provides a matrix of data requirements that are typically determined in the DQO process, the associated interim status regulations applicable to these requirements, and the current and historical documentation specifying how the monitoring program for the B-63 Trench complies with the requirements.

Table 2-1. Data Quality Objectives at RCRA Sites Monitoring for Indicator Parameters

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
Scope	RCRA interim status ground-water monitoring at sites where no impact to ground-water has been identified. Requirements are found in WAC 173-303-400(3) and 40 CFR 265.90 through 265.94, as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v).	
Number and location of wells Point(s) of compliance	**40 CFR 265.91, Ground-Water Monitoring System.** (a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of: (1) Monitoring wells (at least one) installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. Their number, locations, and depths must be sufficient to yield ground-water samples that are: (i) Representative of background ground-water quality in the uppermost aquifer near the facility; and (ii) Not affected by the facility; and (2) Monitoring wells (at least three) installed hydraulically downgradient (i.e., in the direction of decreasing static head) at the limit of the waste management area. Their number, locations, and depths must ensure that they immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer.	This plan, Sections 2.4, 2.5, 2.6, and 3.2 PNNL-14112, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site*
Well configuration (depth and length of screened interval; well construction)	**40 CFR 265.91, Ground-Water Monitoring System.** (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated, and packed with gravel or sand where necessary, to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground-water. **Additional Requirements from WAC 173-303-400(3)(c)(v)(C).** Ground-water monitoring wells must be designed, constructed, and operated so as to prevent ground-water contamination. WAC 173-160 may be used as guidance in the installation of wells.	This plan, Section 3.2 PNNL-14112, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site* BHI-01239, *200-CW-1 Gable/B-Pond and Ditches Cooling Water Waste Group Remedial Investigation DQO Summary Report* BHI-01276, *200-CS-1 Chemical Sewer Operable Unit DQO Process Summary Report*

Table 2-1. Data Quality Objectives at RCRA Sites Monitoring for Indicator Parameters

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
Frequency of sampling Types of analysis or measurement Method detection limits or accuracy and precision	**40 CFR 265.92, Sampling and Analysis.** (b) The owner or operator must determine the concentration or value of the following parameters in ground-water samples in accordance with paragraphs (c) and (d) of this section: (1) Parameters characterizing the suitability of the ground-water as a drinking water supply, as specified in Appendix III. *[Note: Have not listed these because, in accordance with 40 CFR 265.92(c)(1) below, these analyses are only conducted for the first year. None of the RCRA sites are in the first year of monitoring.]* (2) Parameters establishing ground-water quality: (i) Chloride (ii) Iron (iii) Manganese (iv) Phenols (v) Sodium (vi) Sulfate *[Comment: These parameters are to be used as a basis for comparison in the event a ground-water quality assessment is required under 40 CFR 265.93(d).]* (3) Parameters used as indicators of ground-water contamination: (i) pH (ii) Specific Conductance (iii) Total Organic Carbon (iv) Total Organic Halogen (c)(1) For all monitoring wells, the owner or operator must establish initial background concentrations or values of all parameters specified in paragraph (b) of this section. The owner or operator must do this quarterly for one year. (2) For each of the indicator parameters specified in paragraph (b)(3) of this section, at least four replicate measurements must be obtained for each sample and the initial background arithmetic mean and variance must be determined by pooling the replicate measurements for the respective parameter concentrations or values in samples, obtained from upgradient wells during the first year.	This plan, Sections 3.1,3.2, and 3.3; Appendix A PNNL-14112, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site* BHI-01239, *200-CW-1 Gable/B-Pond and Ditches Cooling Water Waste Group Remedial Investigation DQO Summary Report* BHI-01276, *200-CS-1 Chemical Sewer Operable Unit DQO Process Summary Report* SGW-34011, *Data Quality Objectives Summary Report Supporting the 200-PO-1 Groundwater Operable Unit*

Table 2-1. Data Quality Objectives at RCRA Sites Monitoring for Indicator Parameters

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
	40 CFR 265.92, Sampling and Analysis. (cont'd.) (d) After the first year, all monitoring wells must be sampled and the samples analyzed with the following frequencies: (1) Samples collected to establish ground-water quality must be obtained and analyzed for the parameters specified in paragraph (b)(2) of this section at least annually. (2) Samples collected to indicate ground-water contamination must be obtained and analyzed for the parameters specified in paragraph (b)(3) of this section at least semiannually. (e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.	
Methods used to evaluate the collected data	**40 CFR 265.93, Preparation, Evaluation, and Response.** (b) For each indicator parameter specified in 40 CFR 265.92(b)(3), the owner or operator must calculate the arithmetic mean and variance, based on at least four replicate measurements on each sample, for each well monitored in accordance with 40 CFR 265.92(d)(2), and compare these results with its initial background arithmetic mean. The comparison must consider individually each of the wells in the monitoring system, and must use the student's t-test at the 0.01 level of significance (see Appendix IV) to determine statistically significant increases (and decreases, in the case of pH) over initial background.	This plan, Section 3.3 and Appendix A PNNL-14112, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site* BHI-01239, *200-CW-1 Gable/B-Pond and Ditches Cooling Water Waste Group Remedial Investigation DQO Summary Report* BHI-01276, *200-CS-1 Chemical Sewer Operable Unit DQO Process Summary Report* SGW-34011, *Data Quality Objectives Summary Report Supporting the 200-PO-1 Groundwater Operable Unit*

The references cited in this table are listed in the reference section (Chapter 5) of this plan.

CFR = *Code of Federal Regulations*

DQO = data quality objective

RCRA = *Resource Conservation and Recovery Act of 1976*

WAC = *Washington Administrative Code*

3 Groundwater Monitoring Program

This chapter describes an interim status indicator evaluation groundwater monitoring program for the B-63 Trench consisting of a monitoring well network, target constituents, and sampling and analysis protocol. The monitoring program presented herein has been revised from PNNL-14112.

It should be noted that the B-63 Trench will be closed through an approved RCRA closure plan submitted to Ecology. Upon acceptance of the closure plan by Ecology, this RCRA interim status groundwater monitoring plan is expected to no longer be in effect. At that time, groundwater monitoring requirements (pursuant to WAC 173-303-645, "Releases from Regulated Units") and applicable to post-closure care and monitoring for the B-63 Trench will be determined.

3.1 Constituent List and Sampling Frequency

The groundwater in the B-63 Trench monitoring wells will be sampled and analyzed for the parameters listed in Table 3-1. The revised network is made up of two upgradient and five downgradient wells. In compliance with 40 CFR 265.92, the network of groundwater monitoring wells for the B-63 Trench will be monitored semiannually for the indicator parameters TOC, TOX, pH, and specific conductance. Field parameters (i.e., dissolved oxygen, temperature, and turbidity) will also be measured during each sampling event as indicators of groundwater quality and general aquifer/well environmental conditions. Water-level measurements will also be taken semiannually.

All wells will be sampled annually for selected alkalinity, metals, anions, and phenols, including sodium and sulfate (which are likely degradation products of the corrosive wastes listed in the Dangerous Waste Part A Permit Application for the B-63 Trench). Alkalinity will be used to calculate a groundwater charge balance. The major ions may also be evaluated for geochemical relationships (e.g., stiff diagrams).

Maintenance problems and sampling logistics sometimes delay scheduled sampling events. If a well is delayed more than 3 months, that event will be cancelled, as it would be nearly time for the next scheduled sampling event. Missed sampling events are reported in the annual groundwater report.

3.2 Monitoring Well Network

The indicator evaluation groundwater monitoring program consists of the B-63 Trench monitoring network, as described in Table 3-1 and shown in Figure 3-1. Data from the 12 groundwater monitoring wells that currently comprise the B-63 monitoring network were re-evaluated to determine if redundant wells could be dropped from sampling. Based on this re-evaluation, the former network of 12 wells is being reduced to 7 wells. Information on the selected wells is summarized in Table 3-2.

Five upgradient wells will be removed from the network:

- Former upgradient wells 299-E27-8 and 299-E27-9 have similar characteristics to upgradient well 299-E27-17, which will remain in the network. Also, certain constituents in wells 299-E27-8 and 299-E27-9 suggest impact from an outside source.
- Former upgradient wells 299-E33-33 and 299-E33-36 exhibit constituent concentrations similar to well 299-E33-37, which will remain in the network.
- Former upgradient well 299-E34-8 will be dropped because well 299-E34-10 also shows similar constituent concentrations.

Table 3-1. Monitoring Well Network, Constituent List, and Sampling Frequency for the 216-B-63 Trench

			RCRA Required Constituents[a]											Supporting Constituents[b]					
				Indicator Parameters				Groundwater Quality Parameters						Field			Laboratory		
Well	Purpose	WAC-Compliant	Water Level	pH[c]	Specific Conductance[c]	Total Organic Carbon	Total Organic Halogen	Chloride	Iron (Unfiltered)	Manganese (Unfiltered)	Phenols	Sodium (Unfiltered)	Sulfate	Dissolved Oxygen[c]	Temperature[c]	Turbidity[c]	Alkalinity	Anions[d]	Metals[f] (Unfiltered)
299-E27-11	Downgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A
299-E27-16	Downgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A
299-E27-17	Upgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A
299-E27-18	Downgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A
299-E27-19	Downgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A
299-E33-37	Downgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A
299-E34-10	Upgradient	C	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	A	A	A

a. Constituents and parameters required by 40 *Code of Federal Regulations* (CFR) 265.92, "Interim Status Standards for Owners of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Groundwater Monitoring."

b. Constituents are not required by the *Resource Conservation and Recovery Act of 1976* but are needed to support interpretation.

c. Field measurement.

d. Anions; analytes include, but are not limited to, chloride, fluoride, sulfate, nitrate, and nitrite for charge-balance computations.

e. Monitored to show compliance with the *Atomic Energy Act of 1954*.

f. Metals; analytes include, but are not limited to, common soil minerals; calcium, magnesium, potassium, and sodium for charge-balance computations.

A = to be sampled annually

C = constructed as a resource protection well in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

S4 = to be sampled semiannually with quadruplicate samples taken

WAC = *Washington Administrative Code*

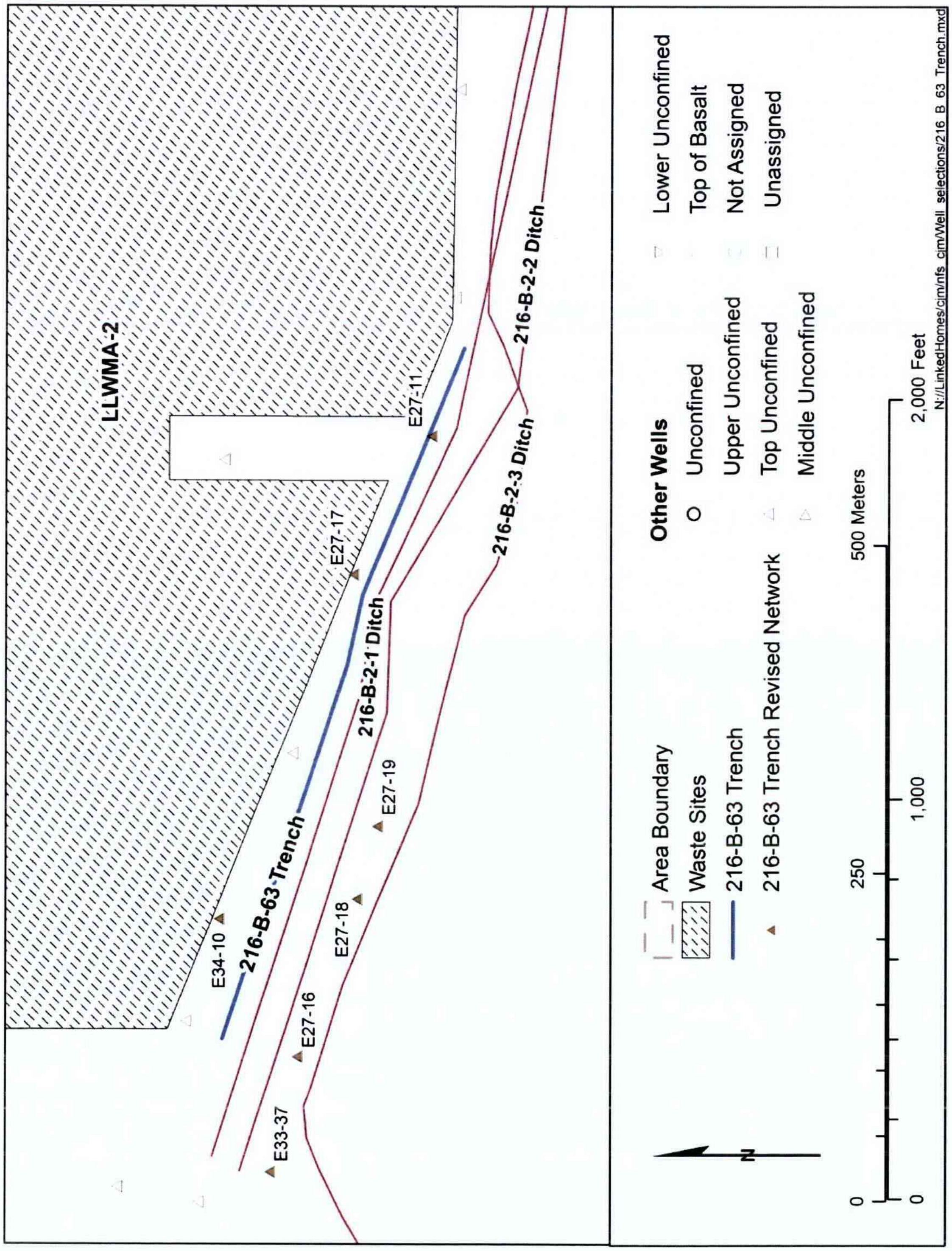

Figure 3-1. Revised 216-B-63 Trench Monitoring Network Wells

Well 299-E27-17 will provide upgradient coverage for the lower half of the B-63 Trench, while coverage of the upper half is provided by well 299-E34-10. Downgradient wells remain concentrated around the head end of the ditch (wells 299-E27-16, 299-E27-18, and 299-E33-37). Wells 299-E27-18 and 299-E27-19 will monitor the central portion of the trench, while well 299-E27-11 monitors the tail end.

The construction details and lithologic information for the B-63 Trench network wells are provided in as-built diagrams in PNNL-14112. Table 3-2 summarizes well construction information, including the current (2009) depth of water in each well. All of the revised groundwater monitoring wells were constructed to meet resource protection well standards (WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells").

3.3 Sampling and Analysis Protocol

Groundwater monitoring at the B-63 Trench is part of the Soil and Groundwater Remediation Program routine network. Sampling and analysis protocols follow the conventions of that project. The QAPjP outlining procedures for sample collection, sample preservation and shipment, analytical procedures, and chain-of-custody control is included as Appendix A.

Table 3-2. 216-B-63 Trench Groundwater Monitoring Well Network

Well	Year Drilled	Construction Notes[a]	Units Monitored	Water Table Elevation[b] (m)	Top of Casing NAVD88 (m)	Bottom Elevation[c] (m)	Water Left (m)
299-E27-11	1989	ss, wire-wrap screen	Hanford formation – completed at water table	121.901	197.163	119.50	2.40
299-E27-16	1990	ss, wire-wrap screen	Hanford formation – completed at water table	121.873	192.862	119.67	2.20
299-E27-17 (upgradient)	1991	ss, wire-wrap screen	Hanford formation – completed at water table	121.923	194.475	118.83	3.09
299-E27-18	1992	ss, wire-wrap screen	Hanford formation – completed at water table	121.878	198.185	119.30	4.69
299-E27-19	1992	ss, wire-wrap screen	Hanford formation – completed at water table	121.852	199.398	117.16	2.58
299-E33-37	1990	ss, wire-wrap screen	Hanford formation – completed at water table	121.917	200.124	119.28	2.64
299-E34-10 (upgradient)	1991	ss, wire-wrap screen	Hanford formation – completed at water table	121.914	196.016	119.82	2.09

Table 3-2. 216-B-63 Trench Groundwater Monitoring Well Network

Well	Year Drilled	Construction Notes[a]	Units Monitored	Water Table Elevation[b] (m)	Top of Casing NAVD88 (m)	Bottom Elevation[c] (m)	Water Left (m)

a. Includes (when available) well casing/screen material, screen type, and well seal type.

b. Water table elevation in October 2009.

c. Bottom elevation from most recently available source (e.g., well inspection depth-to-bottom measurement or bottom of screen from as-built diagram).

NAVD88 = *North American Vertical Datum of 1988*

ss = stainless steel

4 Data Evaluation and Reporting

This chapter discusses the storage, retrieval, evaluation, and interpretation of data. Statistical evaluation methods and reporting requirements are also described.

4.1 Data Review

The data review, validation, and verification process is discussed in the QAPjP in Appendix A.

4.2 Statistical Evaluation

The goal of RCRA indicator evaluation monitoring is to determine if B-63 Trench operations have affected groundwater quality beneath the site. This is determined based on the results of specified statistical tests. Under this plan, sampling procedures and statistical evaluation methods are based on 40 CFR 265, Subpart F (incorporated by reference into WAC 173-303-400). These interim status regulations require the use of a statistical method that compares mean concentrations of the four general contamination indicator parameters (TOC, TOX, pH, and specific conductance) to background levels to test for potential impact to groundwater. Each time a monitoring well is sampled, four replicate samples for TOC and TOX are collected, and four replicate field measurements are made for pH and specific conductance.

Implementation of the statistical test method at the Hanford Site, including the B-63 Trench, is described in more detail in *Hanford Site Groundwater Monitoring for Fiscal Year 1999* (PNNL-13116) and *Statistical Approach on RCRA Groundwater Monitoring Projects at the Hanford Site* (WHC-SA-1124-FP). Twice each year, monitoring data from downgradient wells are compared to the upgradient (background) results to determine (using a t-test) if there is any indication that contamination may have occurred (40 CFR 265.93[b]). Critical mean values are recalculated annually, while limits of quantitation are recalculated quarterly (PNNL-13080, *Hanford Site Groundwater Monitoring: Setting, Sources, and Methods*).

4.3 Interpretation

After data are validated and verified, the acceptable data are used to interpret groundwater conditions at the site. Interpretive techniques include the following:

- Hydrographs: Graph water levels versus time to determine decreases, increases, seasonal, or manmade fluctuations in groundwater levels.
- Water table maps: Use water table elevations from multiple wells to construct contour maps to estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential.
- Trend plots: Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations relate to changes in water level or in groundwater flow directions.
- Plume maps: Map distributions of constituents areally in the aquifer to determine extent of contamination. Changes in plume distribution over time assist in determining movement of plumes and direction of flow.
- Contaminant ratios: Distinguish between different sources of contamination.

4.4 Annual Determination of Monitoring Network

The RCRA groundwater monitoring requirements call for an annual evaluation of the network to determine if it remains adequate to monitor the B-63 Trench. The network must include upgradient and downgradient wells in the uppermost aquifer. The gradient beneath the B-63 Trench is extremely flat but has been estimated to be to the southeast. The network includes both upgradient and downgradient wells based on current estimates of flow direction.

The groundwater monitoring network, as is currently configured, will continue to be re-evaluated to ensure that it is adequate to monitor the changing hydrogeologic conditions beneath the unit. If flow changes are observed, the B-63 Trench conceptual model and geochemical trends will be re-evaluated to determine network efficiency and any necessary modification requirements for the network.

Water-level measurements will continue to be collected before each sampling event. More comprehensive water-level measurements are also made annually for selected wells in the 200 East Area. The wells used for this task have very exacting controls, allowing Soil and Groundwater Remediation Project staff to correct the measurements to account for vertical borehole deviation and barometric effects. The resulting data are used in trend analysis, with statistical evaluation of the significance of a trend on the water table.

4.5 Reporting and Notification

Chemistry and water-level data are reviewed after each sampling event and are available in the Hanford Environmental Information System database. Formal, interpretive reports are issued annually (e.g., DOE/RL-2008-66).

If comparisons for the upgradient well show a statistically significant increase (and/or pH decrease), the information is reported in the annual groundwater report. If comparisons for a downgradient well show a significant increase (and/or pH decrease), then one or both or the following actions are taken: (1) the well is re-sampled and split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error, and/or (2) the original samples may be re-analyzed if laboratory error is suspected.

If an exceedance of a statistical comparison value is confirmed by resampling, then written notice is provided to the regulatory agency within 7 days that the monitored TSD unit may be affecting groundwater quality. Within 15 days after the notification, a groundwater quality assessment program will be developed and submitted. In some instances, it is possible to determine immediately that the statistical finding is not the result of contamination from the TSD unit. In that case, the regulatory agency is notified but an assessment program is not instituted.

5 References

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_09/40cfr261_09.html.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_08/40cfr265_08.html.

40 CFR 265, Subpart F, "Ground-Water Monitoring."

40 CFR 265.90, "Applicability."

40 CFR 265.91, "Ground-Water Monitoring System."

40 CFR 265.92, "Sampling and Analysis."

40 CFR 265.93, "Preparation, Evaluation, and Response."

40 CFR 265.94, "Recordkeeping and Reporting."

ARH-2015, 1971, *Radioactive Liquid Wastes Discharged to Ground in the 200 Areas During 1970*, Part 3, Atlantic Richfield Hanford Company, Richland, Washington.

Atomic Energy Act of 1954, 42 U.S.C. 2011, et seq. Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0980/ml022200075-vol1.pdf#pagemode=bookmarks&page=14.

BHI-00184, 1995, *Miocene- to Pliocene-Aged Suprabasalt Sediments of the Hanford Site, South-Central Washington,* Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-01239, 1999, *200-CW-1 Gable/B-Pond and Ditches Cooling Water Waste Group Remedial Investigation DQO Summary Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-01276, 1999, *200-CS-1 Chemical Sewer Operable Unit DQO Process Summary Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D199159404.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et. seq. Available at: http://www.epa.gov/oecaagct/lcla.html#Hazardous%20Substance%20Responses.

DOE/RL-92-05, 1993, *B Plant Source Aggregate Area Management Study Report*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D196125912. http://www5.hanford.gov/arpir/?content=findpage&AKey=D196125952.

DOE/RL-99-44, 2000, *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D8434677.

DOE/RL-2007-02, 2007, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units: Volume I: Work Plan and Appendices*, and *Volume II: Site-Specific Field-Sampling Plan Addenda*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=00099914. http://www5.hanford.gov/arpir/?content=findpage&AKey=00099913.

DOE/RL-2008-66, 2009, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0905131281. http://www5.hanford.gov/arpir/?content=findpage&AKey=0905131282.

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

PNL-10195, 1994, *Three Dimensional Conceptual Model for the Hanford Site Unconfined Aquifer System: FY 1994 Status Report*, Rev. 0, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D199061222.

PNNL-12261, 2000, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0906180659.

PNNL-13080, 2000, *Hanford Site Groundwater Monitoring: Setting, Sources and Methods*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13080.pdf.

PNNL-13116, 2000, *Hanford Site Groundwater Monitoring for Fiscal Year 1999*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=detail&AKey=D2736610.

PNNL-14112, 2002, *Groundwater Monitoring Plan for the 216-B-63 Trench on the Hanford Site*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14112.pdf.

PNNL-14702, 2006, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14702rev1.pdf.

PNNL-18807, 2009, *Soil Water Balance and Recharge Monitoring at the Hanford Site – FY 09 Status Report*, Pacific Northwest National Laboratory, Richland, Washington.

RCW 70.105, "Public Health and Safety," "Hazardous Waste Management," *Revised Code of Washington*. Available at: http://apps.leg.wa.gov/rcw/dispo.aspx?cite=70.105.

Resource Conversation and Recovery Act of 1976, 42 U.S.C. 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

RHO-CD-673, 1979, *200 Areas Waste Sites*, Rev. 0, Rockwell Hanford Operations, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D196039027.

SGW-34011, 2007, *Data Quality Objectives Summary Report Supporting the 200-PO-1 Groundwater Operable Unit*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

WA7890008967, 1994, *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, as amended, effective September 28, 1994, Washington State Department of Ecology, Olympia, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/wac/default.aspx?cite=173-160.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/wac/default.aspx?cite=173-303.

WAC 173-303-040, "Definitions."

WAC 173-303-400, "Interim Status Facility Standards."

WAC 173-303-645, "Releases from Regulated Units."

WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340.

WHC-EP-0287, 1989, *Waste Stream Characterization Report*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SA-1124-FP, 1991, *Statistical Approach on RCRA Groundwater Monitoring Projects at the Hanford Site*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-EN-AP-165, 1995, *Interim-status Groundwater Monitoring Plan for the 216-B-63 Trench*, Rev. 1, Westinghouse Hanford Company, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D196008979.

WHC-SD-EN-TI-012, 1992, *Geologic Setting of the 200 East Area: An Update*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WMP-17755, 2003, *200-CS-1 Operable Unit Field Summary Report for Fiscal Year 2003*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.
Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D2746991.

WMP-28945, 2007, *Data Quality Objective Summary Report in Support of the 200-BP-5 Groundwater Operable Unit Remedial Investigation/Feasibility Study Process*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

Appendix A

Quality Assurance Project Plan

Contents

Figure

Tables

Terms

CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQO	data quality objective
EB	equipment blank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	Hanford Environmental Information System
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

A Quality Assurance Project Plan

The contractor's quality assurance (QA) program describes the contractor's QA structure, requirements, implementation methods, and responsibilities. The contractor's environmental QA program plan provides the requirements for collecting and assessing environmental data in accordance with the following:

- 10 *Code of Federal Regulations* (CFR) 830, Subpart A, "Nuclear Safety Management," "Quality Assurance Requirements"
- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD)
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5
- U.S. Department of Energy (DOE) O 414.1C, *Quality Assurance*

This quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection including the planning, implementation, and assessment of sampling, field measurements, and laboratory analyses. Section 6.5 and 7.8 of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989a), Attachment 2, "Action Plan," require that QA/quality control (QC) and sampling and analysis activities specify the QA requirements for treatment, storage, and disposal (TSD) units, as well as for past-practice processes. The HASQARD requirements (DOE/RL-96-68) also apply to this work.

The content of this QAPjP is patterned after the QA elements of EPA/240/B-01/003. The QAPjP demonstrates conformance to the Part B requirements of *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use* (ANSI/ASQ E4). This QAPjP is divided into four sections (designated in EPA/240/B-01/003) that describe the quality requirements and controls applicable to this investigation. This QAPjP is intended to supplement the contractor's environmental QA program plan.

A1 Project Management

This section addresses the basic aspects of project management and will ensure that the project has defined goals, that the participants understand the goals and the approaches used, and that the planned outputs are appropriately documented.

A1.1 Project/Task Organization

The project organization in regard to planning, sampling, analysis, and data assessment is described in the following subsections and is shown in Figure A-1. For each functional primary contractor role, there is a corresponding oversight role within DOE.

A1.1.1 Regulatory Project Manager

The Washington State Department of Ecology (Ecology) project manager is responsible for oversight of the work being performed under this groundwater monitoring plan. Ecology will work with the DOE Richland Operations Office (RL) to resolve concerns regarding the work as described in this QAPjP. Ecology can request this plan during a regulatory compliance inspection for review.

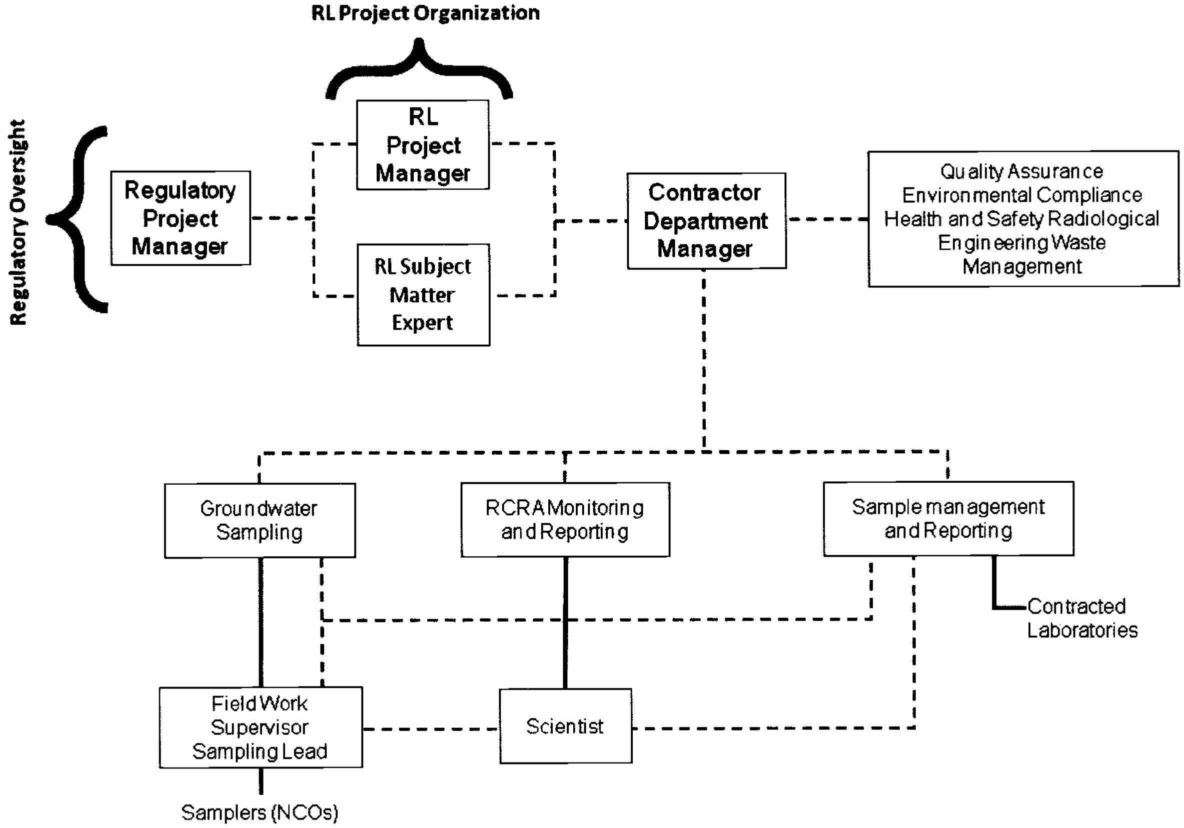

Figure A-1. Project Organization

A1.1.2 U.S. Department of Energy, Richland Operations Office Project Manager

Hanford Site cleanup is the responsibility of RL. The RL project manager is responsible for authorizing the contractor to perform activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*; the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954*; and the Tri-Party Agreement for the Hanford Site.

A1.1.3 U.S. Department of Energy, Richland Operations Office Subject Matter Expert

The RL subject matter expert is responsible for day-to-day oversight of the contractor's performance of workscope, for working with the contractor and the regulatory agencies to identify and work through issues, and for providing technical input to the RL project manager.

A1.1.4 Contractor Groundwater Remediation Department Manager

The contractor groundwater remediation department manager provides oversight for all activities and coordinates with DOE, the regulators, and primary contractor management in support of sampling and reporting activities. The remediation department manager also provides support to the RCRA Monitoring and Reporting manager to ensure that work is performed safely and cost effectively.

A1.1.5 Groundwater Sampling Operations

Groundwater sampling operations is responsible for planning and coordinating field sampling resources and provides the field work supervisor for routine groundwater sampling operations. The field work supervisor directs the samplers, who collect groundwater samples in accordance with the sampling and analysis plan, and corresponding standard procedures and work packages. The samplers also complete the field logbook and chain-of-custody forms, including any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

A1.1.6 RCRA Monitoring and Reporting

The RCRA Monitoring and Reporting manager is responsible for direct management of activities performed to meet RCRA TSD monitoring requirements. The RCRA Monitoring and Reporting manager coordinates with and reports to DOE and primary contractor management regarding RCRA TSD monitoring requirements. The RCRA Monitoring and Reporting manager assigns scientists to provide technical expertise.

A1.1.7 Sample Management and Reporting Organization

The Sample Management and Reporting organization coordinates laboratory analytical work to ensure that laboratories conform to HASQARD requirements (or their equivalent), as approved by DOE, the U.S. Environmental Protection Agency (EPA), and Ecology. Sample Management and Reporting receives analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. Sample Management and Reporting is responsible for informing the RCRA Monitoring and Reporting manager of any issues reported by the analytical laboratories.

A1.1.8 Contract Laboratories

The contract laboratories analyze samples in accordance with established procedures and provide necessary sample reports and explanations of results to support data validation. The laboratories must meet site-specific QA requirements and must have an approved QA plan in place.

A1.1.9 Quality Assurance

The QA point of contact is matrixed to the subject matter expert and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements; reviewing project documents, including data quality objective (DQO) summary reports, sampling and analysis plans, and the QAPjP; and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA point of contact must be independent of the unit generating the data.

A1.1.10 Environmental Compliance Officer

The environmental compliance officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

A1.1.11 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal primary contractor work requirements.

A1.1.12 Waste Management

Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

A1.2 Problem Definition/Background

The problem definition, as required by *Washington Administrative Code* (WAC) 173-303-400 ("Dangerous Waste Regulations," "Interim Status Facility Standards") and 40 CFR 265, Subpart F ("Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Groundwater Monitoring"), is outlined in the main text discussion of this monitoring plan. The background is also provided in the monitoring plan.

A1.3 Project/Task Description

The project description is provided in Chapters 3 and 4 of this monitoring plan and includes the selection of appropriate dangerous waste or dangerous waste constituents, collection and analyses of groundwater from the monitoring network, interpretation of analytical results, evaluation of the monitoring network, and reporting.

The target analytes, along with the monitoring wells and frequency of sampling, are provided in Chapter 3.

A1.4 Quality Objectives and Criteria

The quality objectives and criteria for groundwater monitoring are defined in the tables provided in this QAPjP in order to meet the evaluation requirements stated in the monitoring plan.

A1.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility of collecting and transporting groundwater samples according to the Dangerous Waste Training Plan maintained for the TSD unit to meet the requirements of WAC 173-303-330, "Personnel Training." The field work supervisor, in coordination with line management, will ensure that all field personnel meet training requirements.

A1.6 Documents and Records

The project scientist is responsible for ensuring that the current version of the groundwater monitoring plan is used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Significant changes to the plan that affect DQOs will be reviewed and approved by DOE and the regulatory agency prior to implementation. Table A-1 defines the types of changes that may be made to the sampling design and the documentation requirements.

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The HEIS database will be identified as a data repository for the Hanford Facility Operating Record unit file. Records may be stored in either electronic or hardcopy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement will be managed in accordance with the requirements therein.

Table A-1. Actions and Documentation for Regulatory Notification

Type of Change	Action	Documentation
Temporary addition of wells or constituents, or increased sampling frequency	RCRA Monitoring and Reporting manager approval; notify regulatory agency, if appropriate	Project's schedule tracking system
Unintentional impact to groundwater monitoring plan including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, loss of samples in transit, etc.	Electronic notification	RCRA annual report
Planned change to groundwater monitoring activities, including addition or deletion of constituents or wells, change of sampling frequency, etc.	Revise monitoring plan	Revised RCRA groundwater monitoring plan
Anticipated unavoidable changes (e.g., dry wells)	Electronic notification; revise monitoring plan	RCRA annual report and revised groundwater monitoring plan

RCRA = *Resource Conservation and Recovery Act of 1976*

The results of groundwater monitoring are reported annually in accordance with the requirements of 40 CFR 265.94, "Recordkeeping and Reporting." Reporting will be made in annual Hanford Site groundwater monitoring reports (e.g., DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*).

A2 Data Generation and Acquisition

This section addresses data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented.

A2.1 Sampling Process Design (Experimental Design)

The sampling design is based on regulatory requirements and judgmental sampling.

A2.1.1 Regulatory Requirements

The groundwater protection regulations of WAC 173-303-400 dictate the groundwater sampling and analysis requirements applicable to interim status TSD units.

A2.1.2 Judgmental Sampling

The selection of sampling and analysis requirements is based on knowledge of the feature or condition under investigation and is also based on professional judgment. The TSD monitoring is based on professional judgment. Conclusions depend on the validity and accuracy of professional judgment.

A2.2 Sampling Methods

Sampling is described in the contractor's environmental QA program plan, including the following:

- Field sampling methods
- Sample preservation, containers, and holding times
- Corrective actions for sampling activities
- Decontamination of sampling equipment

The groundwater sampling operations supervisor must ensure that situations that may impair the usability of samples and/or data are documented in field logbooks or on nonconformance report forms in accordance with internal corrective action procedures, as appropriate. The groundwater sampling operations supervisor will note any deviations that occur from the standard procedures for sample collection, contaminants of potential concern, sample transport, or monitoring. The groundwater sampling operations supervisor is also responsible for coordinating all activities related to the use of field monitoring equipment (e.g., dosimeters and industrial hygiene equipment). Field personnel will document in the logbook all noncompliant measurements taken during field sampling. Ultimately, the groundwater sampling operations supervisor is responsible for developing, implementing, and communicating corrective action procedures; for documenting all deviations from procedure; and for ensuring that immediate corrective actions are applied to field activities. Problems with sample collection, custody, or data acquisition that adversely impact data quality or impair the ability to acquire data or failure to follow procedure will be documented in accordance with internal corrective action procedures, as appropriate.

A2.3 Sample Handling and Custody

A sampling and data tracking database is used to track samples from the point of collection through the laboratory analysis process. Laboratory analytical results are entered and maintained in the HEIS database. Each sample is identified and labeled with a unique HEIS sample number. The contractor's environmental QA program plan specifies sample handling information, including the following:

- Container requirements
- Container labeling and tracking process
- Sample custody requirements
- Shipping and transportation

Sample custody during laboratory analysis is addressed in the applicable laboratory's standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by the Sample Management and Reporting organization.

A2.4 Analytical Methods

Information on analytical methods is provided in Tables A-2 and A-3. These analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this QAPjP. The primary contractor participates in oversight of offsite analytical laboratories to qualify the laboratories for performing Hanford Site analytical work.

Table A-2. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for the 216-B-63 Trench Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (μg/L)[c]
Contamination Indicator Parameters			
Total organic carbon	G/P, HCL to pH <2	SW-846[d] Method 9060	1,000
Total organic halides	G, H_2SO_4 to pH <2, no head space	SW-846[d] Method 9020	20
Metals Analyzed by Inductively Coupled Plasma Method – Unfiltered/Filtered			
Calcium	P, HNO_3 to pH <2	SW-846[d] Method 6010B/C, SW-846 Method 6020[e], or EPA/600 Method 200.8[e]	1,000
Cadmium			5
Sodium			500
Manganese			5
Potassium			4,000
Iron			50
Magnesium			750
Trace Metals – Unfiltered/Filtered			
Antimony	P, HNO_3 to pH <2	SW-846 Method 6020 or EPA/600 Method 200.8	6
Barium			5
Beryllium			5
Chromium, (total)			10
Cobalt			20
Copper			10
Nickel			40
Silver			10
Strontium			10
Vanadium			25
Zinc			10
Anions by Ion Chromatography			
Chloride	P	EPA/600 Method 300.0[f]	200
Fluoride			500
Nitrate			250
Nitrite			250
Sulfate			500

Table A-2. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for the 216-B-63 Trench Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (μg/L)[c]
Other			
Alkalinity	G/P	EPA Method[g] 2320, EPA/600 Method 310.1 EPA/600 Method 310.2	5,000
Conductivity, field	Field measurement	Instrument/meter	1 μohm
Dissolved oxygen, field	Field measurement	Instrument/meter	0 mg/L
pH, field measurement	Field measurement	Instrument/meter	0.1
Phenol	G	SW-846 Method 8040, SW-846 Method 8041, SW-846 Method 8270D	5 5 10
Temperature	Field measurement	Instrument/meter	
Turbidity, field measurement	Field measurement	Instrument/meter	0.1 NTU

a. All samples will be collected in plastic (P) or glass (G) containers and will be cooled to 4°C upon collection.

b. Constituents grouped together are analyzed by the same method, unless otherwise indicated.

c. Detection limit units, unless otherwise indicated.

d. SW-846, *Methods for Evaluation of Solid Waste: Physical/Chemical Methods.*

e. SW-846 Method 6010 is the preferred method; however, Method 6020 or EPA/600 Method 200.8 may be used, as long as the method quantitation limit listed is met.

f. Analytical method adapted from Method 300.0, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography* (EPA-600/4-84-017).

g. *Standard Methods for the Examination of Water and Wastewater* (APHA et al. 2005).

ASTM = American Society for Testing and Materials

EPA = U.S. Environmental Protection Agency

N/A = not applicable

NTU = nephelometric turbidity unit

Table A-3. Preservation Techniques, Analytical Methods Used, and the Current Method, Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Trace Metals – Unfiltered/Filtered			
Arsenic	P, HNO_3 to pH <2	SW-846 Method 6020 or EPA/600 Method 200.8	10
Aluminum			50
Boron			20
Bismuth			100
Hexavalent chromium	G/P, cool to 4°C	SW-846 Method 7196	10
Lead	P, HNO_3 to pH <2	SW-846 Method 6020 or EPA/600 Method 200.8	5
Mercury	G, HNO_3 to pH <2	SW-846 Method 7470A, EPA/600 Method 200.8	0.5
Lithium	P, HNO_3 to pH <2	SW-846 Method 6020 or EPA/600 Method 200.8	25
Molybdenum			20
Selenium			10
Silicon			20
Thallium			5
Tin			100
Titanium			5
Zirconium			25
Anions by Ion Chromatography			
Bromide	P	EPA/600 Method 300.0[d]	250
Phosphate			500
Pesticides			
Endrin	G	SW-846 Method 8081B	0.1
Lindane (four isomers)			0.05
Methoxychlor			0.5
Toxaphene			2

Table A-3. Preservation Techniques, Analytical Methods Used, and the Current Method, Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Herbicides			
2,4-D	G	SW-846 Method 8151A	20
2,4-5-TP silvex			1
2,4,5-T			1
Volatile Organic Analyses			
Acetone (by volatile organic analysis)	G, no headspace	SW-846 Method 8260B	20
Benzene			5
Carbon tetrachloride			5
Chloroform			5
1,1,1-trichloroethane			5
1,1,2-trichloroethane			5
1, 1-dichloroethane			10
1, 2-dichloroethane			5
Methylene chloride			5
Methyl ethyl ketone			10
Methyl isobutyl ketone			10
P-dichlorobenzene			5
Trichloroethylene			5
Tetrachloroethylene			5
Tetrahydrofuran			50
Toluene			5
Trans-1, 2-dichloroethylene			5
Vinyl chloride			10
Xylene-m			10
Xylene-o, p			10

Table A-3. Preservation Techniques, Analytical Methods Used, and the Current Method, Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Semivolatile Organic Analyses			
Benzo(a)pyrene	Amber glass	SW-846 Method 8270D	10
Bis(2ethylhexyl)phthalate (DEHP)			10
Cresol (o,p,m)			10
n-nitrosodimethylamine			10
Polychlorinated Biphenyls			
Aroclor-1016	G	SW-846 Method 8082	0.5
Aroclor-1221			0.5
Aroclor-1232			0.5
Aroclor-1242			0.5
Aroclor-1248			0.5
Aroclor-1254			0.5
Aroclor-1260			0.5
Other			
Ammonium ion	P, H_2SO_4 to pH <2	EPA/600 Method 350.1, EPA/600 Method 300.7	50
Coliform bacteria	P	EPA Method[e] 9223[f]	2.2[g]
Conductivity, laboratory	P	Instrument/meter	1 µohm
Cyanide	P, NaOH to pH >12	SW-846 Method 9012, EPA Method[e] 4500, EPA/600 Method 335.2	5
Hydrazine	G, HCl	ASTM D1385	100
pH, laboratory measurement	P	Instrument/meter	0.1
Oxidation-reduction potential, field	Field measurement	Instrument/meter	
Temperature	Field measurement	Instrument/meter	
Total dissolved solids	P	EPA/600 Method 160.1	10,000
Total organic halogen	G, H_2SO_4 to pH <2, no headspace	SW-846 Method 9020	20
Total organic carbon	G, HCL or H_2SO_4 to pH <2	SW-846 Method 9060	1,000

Table A-3. Preservation Techniques, Analytical Methods Used, and the Current Method, Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]

a. All samples will be collected in plastic (P), glass (G), or amber glass containers and will be cooled to 4°C upon collection.

b. Constituents grouped together are analyzed by the same method, unless otherwise indicated.

c. Detection limit units, unless otherwise indicated.

d. Analytical method adapted from Method 300.0, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography* (EPA-600/4-84-017).

e. *Standard Methods for the Examination of Water and Wastewater* (APHA et al. 2005).

f. Enzyme substrate test.

g. Most probable number.

ASTM = American Society for Testing and Materials

EPA = U.S. Environmental Protection Agency

NTU = nephelometric turbidity unit

Laboratories providing analytical services in support of this QAPjP will report errors to the Sample Management and Reporting project coordinator, who will then initiate a sample disposition record. The error-reporting process is intended to document analytical errors and the resolution of those errors with the project scientist. The corrective action program addresses the following:

- Evaluation of impacts of laboratory QC failures on data quality
- Root-cause analysis of QC failures
- Evaluation of recurring conditions that are adverse to quality
- Trend analysis of quality-affecting problems
- Implementation of a quality improvement process
- Control of nonconforming materials that may affect quality

A2.5 Quality Control

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table A-4.

Table A-4. Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field QC		
Full trip blank	Contamination from containers or transportation	1 per 20 well trips
Field transfer blank	Contamination from sampling site	1 each day; volatile organic compounds sampled
Equipment blank	Contamination from non-dedicated equipment	As needed[a]
Replicate/duplicate samples	Reproducibility	1 per 20 well trips
Laboratory QC		
Method blanks	Laboratory contamination	1 per batch
Laboratory duplicates	Laboratory reproducibility	See footnote[b]
Matrix spikes	Matrix effect and laboratory accuracy	See footnote[b]
Matrix spike duplicates	Laboratory reproducibility/accuracy	See footnote[b]
Surrogates	Recovery/yield	See footnote[b]
Laboratory control samples	Method accuracy	1 per batch

a. For portable Grundfos® (registered trademark of Grundfos Pumps Corporation, Colorado Springs, Colorado) pumps, equipment blanks are collected 1 per 10 well trips. Whenever a new type of non-dedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.

b. As defined in the laboratory contract or quality assurance plan, and/or analysis procedures.

QC = quality control

A2.5.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and field sampling performance. The QC samples and the required frequency for collection are described in this section.

Full trip blanks (FTBs) are prepared by the sampling team prior to traveling to the sampling site. The FTB is filled with high-purity reagent water. The bottles are sealed and transported, unopened, to the field in the same storage containers used for samples collected that day. Collected FTBs are analyzed for the same constituents as the samples. The FTBs are used to evaluate potential contamination of the samples due to the sample bottles, preservative, handling, storage, or transportation.

Field transfer blanks (FXRs) are preserved volatile organic analysis sample bottles that are filled at the sample collection site with high-purity reagent water that has been transported to the field. After collection, FXR bottles are sealed and placed in the same storage containers with the samples from the associated sampling event. The FXR samples are analyzed for volatile organic compounds only. The FXRs are used to evaluate potential contamination caused by conditions in the field.

Equipment blanks (EBs) are samples in which high-purity reagent water is passed through the pump or placed in contact with the sampling surfaces of the equipment to collect blank samples identical to the sample set that will be collected. The EB bottles are placed in the same storage containers with the samples from the associated sampling event. The EB samples are analyzed for the same constituents as the samples from the associated sampling event. The EBs are used to evaluate the effectiveness of the cleaning process to ensure that samples are not cross-contaminated from previous sampling events.

For the field blanks (i.e., FTBs, FXRs, and EBs), results above two times the method detection limit are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit.

Field duplicates, also known as replicates, are two samples that are collected as close as possible to the same time and same location, and they are intended to be identical. Field duplicates are stored and transported together and are analyzed for the same constituents. The field duplicates are used to determine precision for both sampling and laboratory measurements. The results of the field duplicates must have precision within 20 percent, as measured by the relative percent difference. Only field duplicates with at least one result greater than five times the method detection limit or minimum detectable activity are evaluated.

Double-blind samples contain a concentration of analyte known to the supplier but unknown to the analyzing laboratory. The laboratory is not informed that the samples are QC samples. The project submits double-blind samples to assess analytical precision and accuracy.

A2.5.2 Laboratory Quality Control Samples

The laboratory QC samples (e.g., method blanks, laboratory control sample/blank spikes, and matrix spikes) are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, and will be run at the frequency specified in that reference, unless superseded by agreement.

A2.5.3 Quality Control Requirements

Table A-5 lists the acceptance criteria for QC samples, and Table A-6 lists the acceptable recovery limits for the double-blind standards. These samples are prepared by spiking Hanford Site background well water with known concentrations of constituents of interest. Spiking concentrations range from the detection limit to the upper limit of concentration determined in groundwater on the Hanford Site. Investigations shall be conducted for double-blind standards that are outside of acceptance limits. The results from these standards are used to determine the acceptability of the associated parameter data.

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity Conductivity pH Total organic carbon Total organic halides	MB[b]	<MDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	DUP	≤20% RPD[c]	Data reviewed[d]
	MS[e]	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action
Ammonia and Anions			
Anions by IC	MB	<MDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	DUP	≤20% RPD[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Metals			
Cadmium Chromium ICP metals ICP/MS metals	MB	<CRDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	MSD	≤20% RPD[c]	Data reviewed[d]
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Semivolatile Organic Compounds			
Phenols by GC	MB	<2 times MDL	Flagged with "B"
	LCS	Statistically derived[g]	Data reviewed[d]
	MS	Statistically derived[g]	Flagged with "N"
	MSD	Statistically derived[g]	Data reviewed[d]
	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"

a. Refer to Tables A-2 and A-3for specific analytical methods.

b. Does not apply to pH.

c. Laboratory-determined, statistically derived control limits may also be used. Such limits are reported with the data.

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag) or rejected ("R" flag).

e. Applies to total organic carbon and total organic halides only.

f. Applies only in cases where one or both results are greater than five times the detection limit.

g. Determined by the laboratory based on historical data. Control limits are reported with the data.

h. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is less than five times the MDL.

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action

Data flags:

B, C = possible laboratory contamination (analyte was detected in the associated method blank)

N = result may be biased (associated matrix spike result was outside the acceptance limits)

Q = problem with associated field QC sample (blank and/or duplicate results were out of limits)

Abbreviations:

CRDL	=	contract-required detection limit
DUP	=	laboratory matrix duplicate
EB	=	equipment blank
FTB	=	full trip blank
FXR	=	field transfer blank
GC	=	gas chromatography
IC	=	ion chromatography
ICP	=	inductively coupled plasma
ICP/MS	=	inductively coupled plasma/mass spectrometry
LCS	=	laboratory control sample
MB	=	method blank
MDA	=	minimum detectable activity
MDL	=	method detection limit
MS	=	matrix spike
MSD	=	matrix spike duplicate
QC	=	quality control
RPD	=	relative percent difference
SUR	=	surrogate

Holding time is the elapsed time period between sample collection and analysis. The contractor's environmental QA program plan provides a table with holding times. Exceeding the required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Recommended holding times depend on the analytical method, as specified in SW-846 or *Methods of Chemical Analysis of Water and Wastes* (EPA/600/4-79/020). Data associated with exceeded holding times are flagged with an "H" in the HEIS database. Data that exceed the holding time shall be maintained but potentially may not be used in statistical analyses.

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. The groundwater project periodically audits the analytical laboratories to identify and solve quality problems, or to prevent such problems from occurring. Audit results are used to improve performance, and the summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

Table A-6. Blind Standard Constituents and Schedule

Constituents	Frequency	Accuracy (%)	Precision (% RSD)[a]
Fluoride	Quarterly	±25%	≤25%
Nitrate	Quarterly	±25%	≤25%
Chromium	Annually	±20%	≤25%
Total organic carbon[b]	Quarterly	Varies according to spiking compound	Varies according to spiking compound
Total organic halides[c]	Quarterly	Varies according to spiking compound	Varies according to spiking compound

a. If the results are less than five times the required detection limit, then the criterion is that the difference of the results of the replicates is less than the required detection limit.

b. The spiking compound generally used for TOC is potassium phthalate. Other spiking compounds may also be used.

c. Two sets of spikes for TOX will be used. The spiking compound for one set should be 2,4,5-trichlorophenol. The spiking compound for the second set should include the constituents used for the volatile organic compounds sample (carbon tetrachloride, chloroform, and trichloroethylene).

RSD = relative standard deviation

Failure of QC will be determined and evaluated during data validation and the data quality assessment process. Data will be qualified, as appropriate.

A2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to minimize measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and the onsite organization's QA plan or operating procedures, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with SW-846, or with auditable HASQARD and contractual requirements. Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use.

A2.7 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in the environmental QA program plan. Standards used for calibration will be certified and traceable to nationally recognized performance standards. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan.

A2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables used to support sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the contractor's acquisition system and the responsibilities and interfaces necessary to ensure that items procured/acquired for contractor meet the specific technical and quality requirements. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables that are procured by the analytical laboratories are procured, checked, and used in accordance with the laboratory's QA plan.

A2.9 Non-Direct Measurements

Non-direct measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. If evaluation includes data from historical sources, whenever possible such data will be validated to the same extent as the data generated as part of this effort. All data used in evaluations will be identified by source.

A2.10 Data Management

The Sample Management and Reporting organization, in coordination with the RCRA Monitoring and Reporting manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements that govern data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri Party Agreement Action Plan (Ecology et al. 1989b). The HEIS database will be identified as a data repository for the Hanford Facility Operating Record unit file.

All field activities will be recorded in the field logbook.

Laboratory errors are reported to the Sample Management and Reporting organization on a routine basis. For reported laboratory errors, a sample disposition record will be initiated in accordance with contractor procedures. This process is used to document analytical errors and to establish resolution of the errors with the RCRA Monitoring and Reporting manager. Sample disposition records become a permanent part of the analytical data package for future reference and for records management.

A3 Assessment and Oversight

The elements discussed in this section address the activities for assessing the effectiveness of project implementation and the associated QA and QC activities. The purpose of the assessment is to ensure that the QAPjP is implemented as prescribed.

A3.1 Assessments and Response Actions

The contractor management, Regulatory Compliance, Quality, and/or Health and Safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this QAPjP.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratory's QA plan. The primary contractor conducts oversight of offsite analytical laboratories to qualify the laboratories for performing Hanford Site analytical work.

A3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the Sample Management and Reporting organization, which initiates a sample disposition record in accordance with contractor procedures. This process is used to document analytical or sample issues and to establish resolution with the RCRA Monitoring and Reporting manager.

A4 Data Validation and Usability

The elements in this section address the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying project objectives. These elements are further discussed in the contractor's environmental QA program plan.

A4.1 Data Review, Verification, and Validation

The criteria for verification may include review for completeness (e.g., all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

A4.2 Verification and Validation Methods

The work activities shall follow documented procedures and processes for data validation and verification, as summarized below. Validation of groundwater data consists of assessing whether the data collected and measured truly reflect aquifer conditions. Verification means assessing data accuracy, completeness, consistency, availability, and internal control practices to determine overall reliability of the data collected. Other DQOs that shall be met include proper chain-of-custody, sample handling, use of proper analytical techniques as applied for each constituent, and the quality and acceptability of the laboratory analyses conducted.

Groundwater monitoring staff perform checks on laboratory electronic data files for formatting, allowed values, data flagging (i.e., qualifiers), and completeness. Hardcopy results are verified to check for (1) completeness, (2) notes on condition of samples upon receipt by the laboratory, (3) notes on problems encountered during analysis of the samples, and (4) correct reporting of results. If data are incomplete or deficient, staff work with the laboratory to correct the problem found during the analysis.

The data validation process provides the requirements and guidance for validating groundwater data that are routinely collected. Validation is a systematic process of reviewing verified data against a set of criteria (provided in Section A2.5) to determine whether the data are acceptable for their intended use.

Results of laboratory and field QC evaluations, double-blind sample results, laboratory performance evaluation samples, and holding-time criteria are considered when determining data usability. Staff review the data to identify whether observed changes reflect changes in groundwater quality or potential data errors, and they may request data reviews of laboratory, field, or water-level data for usability purposes. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be resampled. Results of the data reviews are used to flag the data appropriately in the HEIS database (e.g., "R" for reject, "Y" for suspect, or "G" for good) and/or to add comments.

A4.3 Reconciliation with User Requirements

The data quality assessment process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet project DQOs. The RCRA Monitoring and Reporting manager is responsible for determining if data quality assessment is necessary and for ensuring that, if required, one is performed. The results of the data quality assessment will be used in interpreting the data and determining if the objectives of this activity have been met.

A5 References

10 CFR 830, Subpart A, "Nuclear Safety Management," "Quality Assurance Requirements," *Code of Federal Regulations*.
Available at: http://edocket.access.gpo.gov/cfr_2008/janqtr/pdf/10cfr830.7.pdf.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*.
Available at: http://www.access.gpo.gov/nara/cfr/waisidx_08/40cfr265_08.html.

40 CFR 265.93, "Preparation, Evaluation, and Response."

40 CFR 265.94, "Recordkeeping and Reporting."

ANSI/ASQ E4, 2004, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*, American National Standards Institute/American Society for Quality, Milwaukee, Wisconsin.

APHA, AWWA, and WEF, 2005, *Standard Methods for the Examination of Water and Wastewater*, 21st Edition, American Public Health Association, American Water Well Association, and Water Environment Federation, Washington, D.C.

Atomic Energy Act of 1954, 42 U.S.C. 2011, et seq. Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0980/ml022200075-vol1.pdf#pagemode=bookmarks&page=14.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq. Available at: http://www.epa.gov/oecaagct/lcla.html#Hazardous%20Substance%20Responses.

DOE O 414.1C, *Quality Assurance*, U.S. Department of Energy, Washington, D.C.
Available at: http://www.directives.doe.gov/pdfs/doe/doetext/neword/452/o4521c.html.

DOE/RL-96-68, 2007, *Hanford Analytical Services Quality Assurance Requirements Document*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2008-66, 2009, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://www5.hanford.gov/arpir/?content=findpage&AKey=0905131281.
http://www5.hanford.gov/arpir/?content=findpage&AKey=0905131282.

Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.
Available at: http://www.hanford.gov/?page=91&parent=0.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Quality Assurance Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/QUALITY/qs-docs/r5-final.pdf.

EPA-600/4-79-020, 1983, *Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, Washington, D.C.

EPA-600/4-84-017, 1984, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography*, U.S. Environmental Protection Agency, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 1997, *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods*, 3rd Edition, as amended, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/waste/hazard/testmethods/sw846/online/index.htm.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/wac/default.aspx?cite=173-303.

WAC 173-303-330, "Personnel Training."

WAC 173-303-400, "Interim Status Facility Standards."

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Quality Assurance Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/QUALITY/qs-docs/r5-final.pdf.

EPA-600/4-79-020, 1983, *Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, Washington, D.C.

EPA-600/4-84-017, 1984, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography*, U.S. Environmental Protection Agency, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 1997, *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods*, 3rd Edition, as amended, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/waste/hazard/testmethods/sw846/online/index.htm.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/wac/default.aspx?cite=173-303.

WAC 173-303-330, "Personnel Training."

WAC 173-303-400, "Interim Status Facility Standards."

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